

A possible new amphicyonid from the Miocene of the Linxia Basin

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Abstract Here we report a new form of amphicyonid from an uncertain locality in the Linxia Basin. The derived dental traits imply an affinity to *Magericyon*, previously known from Europe and possibly southern Asia. The specimen suggests a higher diversity of amphicyonids in eastern Asia than previously thought, and more discovery with stratigraphic information will be needed to elucidate the evolution of Amphicyonidae in eastern Asia.

Key words China, Amphicyonidae, *Magericyon*

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Amphicyonidae were once-flourished carnivores in the Cenozoic, with a wide distribution and high diversity, especially in the Oligocene and Miocene (Kuss, 1965; Viranta, 1996; Hunt, 1998; Ginsburg, 1999). The records are mostly enriched in Europe and North America (Kuss, 1965; Viranta, 1996; Hunt, 1998; Ginsburg, 1999; Morales et al., 2019, 2021a, b), somewhat fewer in Africa (Morales et al., 2016), but only a few, mostly fragmented, records are known from eastern Asia (Qiu et al., 1986; Wang et al., 2005; Jiangzuo et al., 2018, 2019a, b; Sun et al., 2021). Therefore, any new specimens found in East Asia are worth reporting.

Recently, a partial mandible with most of the cheek teeth was donated to the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences (IVPP). The specimen was discovered by a local farmer from Hezheng County and sold to the donor. Unfortunately, the exact locality information was not known. Judging from the surrounding sediment (red clay), the specimen is most likely from the Late Miocene, but could also be

from the late Middle Miocene, the age of previously described *Gobicyon* from the same region (Jiangzuo et al., 2019b). The specimen exhibits traits that differ from all previously known amphicyonids from both Europe and Asia and is likely to represent a new species. However, the lack of precise stratigraphic constraints downgrade its value as potential type of a new species. Here we report the discovery of the specimen but do not erect species on it, awaiting further material with associated locality information and stratigraphic constraints.

Abbreviations IVPP, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences, China; MNCN, Museo Nacional de Ciencias Naturales, Madrid, Spain; UNSM, University of Nebraska State Museum, Lincoln, NE, USA.

Order Carnivora Bowdich, 1821

Suborder Caniformia Kretzoi, 1943

Infraorder Arctoidea Flower, 1869

Family Amphicyonidae Trouessart, 1885

Subfamily Amphicyoninae Trouessart, 1885

Genus *Magericyon* Peigné et al., 2008

***Magericyon* sp.**

(Fig. 1–3)

Description IVPP V33030 (Fig. 1) is a partial left mandible preserving most of the horizontal ramus, which is broken away distal to the m2. The ramus deepens backwards. The symphysis is strong, elongated and rugose. Its posterior border reaches the level of the p2. There are four small mental foramina in the lateral side of the ramus, roughly underneath the canine, p2/p3, p3/p4, and p4, respectively.

The incisors and canine are broken. Judging from the alveolus, the canine is large and robust. There is a long diastema between the canine and the p1 (diastema 17.88 mm). The p1 and p2 are close together (diastema 0.96 mm), both are small, button shaped and single rooted. The p2 is slightly longer and much wider than the p1. The p3 is much more elongated and double-rooted. It also has a very low crown, comparable to that of the p1 and p2. The diastema between the p2 and p3 is large (diastema 8.72 mm), and the diastema between the p3 and p4 is small (diastema 1.24 mm). The p4 is much larger and higher than the anterior premolars, but it is still relatively small compared with the m1. There are weak anterior and posterior cingulid cuspids. Laterally, both the anterior and posterior profiles of the tooth are concave. The distal ridge is slightly serrate on its posterior half.

The m1 is elongated. In the lateral view, the ventral convexity of the enamel is moderately developed between the trigonid and the talonid. Among the three major cuspids, the paraconid, protoconid and hypoconid are tall, with the paraconid and hypoconid subequal in height. The metaconid and entoconid are very reduced but present. The talonid is broader than the trigonid. There are two distal ridges of the protoconid, one connected to the hypoconid

and one containing the metaconid. The entoconid is curved. The m2 is broken at the level of the roots. Judging by the alveolus, it is double-rooted, and probably relatively short.



Fig. 1 *Magericyon* sp. (IVPP V33030) from an unknown locality, Linxia Basin

Comparison The fossil material of Amphicyonidae is mostly fragmented, represented by jaw fragments or isolated teeth, with only a few known to have complete crania and mandibles (Viranta, 1996). The strongly reduced premolars in IVPP V33030 indicate an affinity to either Amphicyoninae or Thaumastocyoninae. Thaumastocyoninae are medium-sized to large amphicyonids, with typically hypercarnivorous dentition (Morales et al., 2019, 2021a). Two evolutionary tendencies of this lineage include the reduced premolars, and high-crowned molars, with reduced lingual cusps and functioning as strict shearing cutting apparatus (Morlo et al., 2020). The subfamily includes *Thaumastocyon*, *Peignecyon*, *Tomocyon*, *Agnotherium*, and *Ammitocyon* (Viret, 1929; Kuss, 1965; Morales et al., 2019, 2020, 2021a). Amphicyoninae typically has moderately reduced premolars, and low-crowned molars that function as both cutting and crushing tools (Kuss, 1965; Viranta, 1996; Hunt, 1998; Ginsburg, 1999). However, the derived forms of this subfamily also convergently reduced their premolars, and developed



Fig. 2 Comparison of *Magericyon* sp. and related taxa

A. *Magericyon* sp., IVPP V33030; B. *Magericyon anceps* B-3139, Batallones-1; C. *Magericyon castellanus*, MNCN 3836 (mirrored), Los Valles de Fuentidueña; D. *Heizmannocyon steinheimensis*, UNSM cast, Steinheim (note that the horizontal corpus is mainly reconstructed); E. *Amphicyon major*, Sa844, Sansan; F. *Lonchocyon qiui*, IVPP V 28616, Baron Sog Formation, Erlan Basin. The dotted line represents the level of canine and m1 of *Magericyon* sp. nov., IVPP V33030

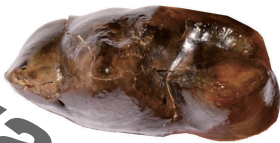
high-crowned cheek teeth, as seen, for example, in *Hubacyon* and *Magericyon* (Kretzoi, 1985; Peigné et al., 2008).

The strongly reduced premolars and short rostrum observed in V33030 suggest an affinity to either Thaumastocyoninae or derived Amphicyoninae. However, the p4 is relatively small compared to the m1, with reduced posterior accessory cuspid. In Thaumastocyoninae, the p4 is typically large, high-crowned and posteriorly orientated, with a strong posterior accessory cuspid, forming the cutting apparatus together with the m1 (Morales et al., 2019, 2020, 2021a).

Hubacyon gutmanni

Heizmannocyon steinhemensis

Tomocyon grivensis



Amphicyon giganteus

Mageriocyon anceps

Mageriocyon sp.

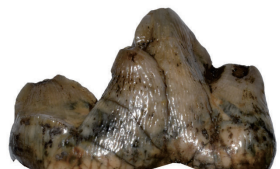
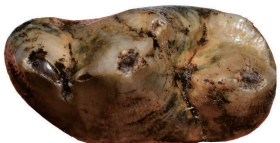


Fig. 3 Comparison of m1s of several amphicyonids mentioned in this study
Not to scale

The p4 of the new amphicyonid is much lower than the m1, and is unlikely to form a similar function as seen in Thaumastocyoninae. The m1 of this specimen shows horizontal wear facets in the paraconid and hypoconid. These traits suggest that this specimen does not belong to Thaumastocyoninae.

In fact, the reduced size of the premolars, especially the p4, is observed in derived amphicyonids such as *Heizmannocyon* and *Magericyon* from the late Middle Miocene and Late Miocene (Fraas, 1885; Helbing, 1936; Heizmann, 1973; Ginsburg et al., 1981; Peigné et al., 2008). The ratio of p4/m1 length is similar in both genera (all < 0.5). The anterior premolars of *Heizmannocyon* are larger than those of V33030, whereas the two species of *Magericyon*, *Magericyon anceps* and *M. castellanus*, have more reduced premolars, some of which are absent. The p4 of *Heizmannocyon* still has a posterior accessory cuspid, which is absent in V33030 and *Magericyon*. The m1s of both known species of *Magericyon* lack the metaconid, which is present in V33030 and *Heizmannocyon*. The overall m1 shape of the specimen is elongate and narrow, similar to that of *Magericyon*, whereas the m1 of *Heizmannocyon* is much wider. Another Late Miocene amphicyonid is *Hubacyon*, which also possesses a somewhat similar m1 shape and tooth development (Kretzoi, 1985), but the talonid is much higher. Unfortunately, *Hubacyon* is only known from the m1, and no further comparison is possible.

A new basal arctoid with possible affinity to Amphicyonidae, *Lonchocyon*, has recently been described from the Late Eocene deposits of the Baron Sog Formation, Erlian Basin, East Asia (Zhang et al., 2023). V33030 is comparable to it in the reduced premolars. However, the p4 of V33030 is not so reduced as seen in *Lonchocyon*, and its m1 is much larger. The V33030 is unlikely to come from deposits of similar age and is probably not related to *Lonchocyon*.

In summary, the IVPP V33030 shows intermediate traits between *Heizmannocyon* and *Magericyon*, but also possesses unique traits, such as the premolar arrangement, and a wide m1 talonid. Its resemblance to *Magericyon* is supported by the synapomorphy of p4, the loss of the posterior accessory cuspid, and a narrow m1. We therefore tentatively assign the specimen to *Magericyon*. It is undoubtedly distinct from the two known European species and should represent a new species. New fossil discoveries and chronological information will be needed to elucidate the evolution of this amphicyonid.

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临夏盆地中新世一可能的新犬熊

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摘要: 报道了临夏盆地具体产地未知的一件犬熊下颌。该下颌展现出进步的牙齿特征, 与过去发现于欧洲以及南亚的马德里犬熊 *Magericyon* 近似。这件犬熊化石指示东亚的犬熊多样性比以往认知的更高, 但还需要更多具有明确层位信息的犬熊化石来进一步揭示东亚犬熊的演化。

关键词: 中国, 犬熊科, 马德里犬熊

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